

14 June 1939

NRL Report No. B-1 39

NAVY DEPARTMENT  
BUREAU OF ENGINEERING

Report of Test

on

Sirens, Types S1-S2, and S3-S4

Submitted by E. D. Bullard Company

San Francisco, California

NAVAL RESEARCH LABORATORY  
ANACOSTIA STATION  
WASHINGTON, D. C.

Number of Pages: Text - 7 Tables - 1 Plates - 2

Authorization: BuEng. ltr. S65-4/L5 (5-10-Ds) of  
24 May 1939.

Date of Test: May and June 1939.

Tested by: G. K. C. Hardesty, Sr. Engineering Aide.

Prepared by: W. B. Roberts, Chief Engineering Aide,  
Chief of Section.

Reviewed by: J. A. Morrison, Lieutenant, U.S.N.

Approved by: H. M. Cooley, Captain, U.S.N., Director.

Distribution:  
BuEng. (5)

jlh

APPROVED FOR PUBLIC  
RELEASE - DISTRIBUTION  
UNLIMITED

F-1539

## TABLE OF CONTENTS

<u>Subject</u>	<u>Page</u>
1. Authorization for Test. . . . .	1
2. Object of Test. . . . .	1
3. Abstract of Test . . . . .	1
(a) Conclusions . . . . .	1a
(b) Recommendations . . . . .	1b
4. Description of Material . . . . .	2
5. Method of Test . . . . .	3
6. Results of Test. . . . .	4
7. Conclusions. . . . .	7

## APPENDICES

Characteristics with Standard and Experimental Rotors - Table 1	
Photograph of Type S1-S2 Siren, assembled. . . . .	- Plate 1
Photograph of Type S3-S4 Siren, assembled. . . . .	- Plate 2

### AUTHORIZATION FOR TEST

1. This problem was authorized by reference (a), and other additional references pertinent to this problem are listed as references (b), (c), (d), and (e).

Reference: (a) BuEng. ltr. S65-4/L5(5-10-Ds) of May 1939.  
(b) Specifications 17S11(INT) of 15 February 1938.  
(c) NRL Report B-1408 of 8 November 1937.  
(d) E. D. Bullard Co. Dwg. #1502.  
(e) BuEng. ltr. S65-4/L5(12-7-Ds) of January 1939 to E. D. Bullard Co., copy to NRL.

### OBJECT OF TEST

2. The object of this test was to determine conformance of the sample sirens with the specifications, reference (b), and their suitability for Naval use.

### ABSTRACT OF TEST

3. The sample sirens were set up at this Laboratory in suitable test circuits where their performance was carefully observed for compliance with the requirements. An inspection of the samples, to determine compliance in the matter of materials, design and workmanship, concluded the test.

## Conclusions

a) The sample sirens failed to meet the following requirements of the specifications:

### Type S1-S2

Nameplate (stainless steel).

Finish coat of grey paint.

### Type S3-S4

Nameplate (stainless steel).

Finish coat of grey paint.

Dielectric.

Insulation resistance.

The power consumption was too high at the start of test, but reached a satisfactory value during the endurance tests.

b) The nameplate material should have been of copper-nickel alloy as required by reference (e).

c) The breakdown, under the dielectric test, occurred on one of the brush holders of the S3-S4 siren, piece 15, after the endurance test.

d) The use of the experimental rotors, suggested under manufacturer's letter (enclosure (A) of reference (a)) does not appear to be justified. As is shown by the data of Table 1, their use increases the power consumption without improvement in the characteristics tabulated. No tests were made to verify the manufacturer's claim that their use reduces the temperature rise of the motors through more efficient cooling as the temperature rise of the motors using the standard rotor was satisfactory.

e) As a result of Laboratory experience in changing the rotors several times, it is believed that some simple modification should be made to definitely locate the rotor and establish its clearance in relation to the stator and motor plate. This could be accomplished by the use of a "step" in the motor shaft or rotor bushing, or both.



### Recommendations

(a) In view of the sample sirens having been satisfactory during the test, they are recommended for Naval use, provided a satisfactory nameplate and finish coat of grey paint are incorporated. The dielectric breakdown of one brush holder is believed to be a defect in manufacture and not representative of the design.

(b) The use of the experimental rotors is not recommended for the reasons given under "Conclusions".

#### DESCRIPTION OF MATERIAL UNDER TEST

4. The sample sirens submitted for test were manufactured by E. D. Bullard Company, San Francisco, California. They are identical in construction and design, except that the rotors and stators vary in the number of apertures.

5. The cases, of cast aluminum alloy, are equipped with two (2) bosses, tapped for 3/4 inch terminal tubes, and three (3) mounting lugs.

6. The motor brush holders are located in bosses on each side of the case and are accessible by removing an oval headed steel screw, equipped with a rubber gasket.

7. The tapered type rotor and stator are of cast aluminum alloy, the rotor being clamped to the armature shaft by means of a split steel bushing which grips the shaft when a brass acorn nut is screwed down. The stator is held in place by six (6) No. 8-32 fillister headed steel machine screws, zinc plated.

8. The terminal block, of phenolic material, is equipped with terminal lugs and is reached by removing a cast aluminum alloy cover from the side of the case. A stainless steel etched and stamped nameplate is secured to the cover with two (2) No. 4-36 fillister headed steel machine screws, zinc plated.

9. Further details in the construction and design of the sirens are given by photographs, Plates 1 and 2, and by drawing, reference (d).

10. Two extra rotors of an experimental design were also received. They are as shown on manufacturer's drawing, reference (d), except that five holes, 3/16 inch diameter, are drilled in their bases around the skirted clamping nut. These holes are for the purpose of drawing air in between the rotor and the finned motor and plate (pc. 1) to aid the dissipation of heat.

## METHOD OF TEST

11. The sirens, as received, were first checked against drawing, reference (d), and then tested to determine their electrical characteristics, sound pressure output and pitch of note at rated voltage and frequency.

12. They were next tested for endurance by operating them "one minute on" and "one minute off" for a period of 1500 cycles, the first 750 cycles at an ambient temperature of 60°C and the second at 0°C.

13. Then followed the test for shock integrity by mounting them on a standard Navy shock stand and subjecting them to 20 shocks of 250 foot pounds each as specified in paragraph F-2g of reference (b).

14. Their resistance to vibration was next determined by mounting them on a standard Navy 3 foot pound vibration machine and subjecting them to six tests of 30 minutes each at 100, 150, 200, 250, 300 and 350 shocks per minute.

15. They were next checked for operation when inclined in all planes and supplied with  $\pm 10$  per cent rated voltage and frequency as specified in paragraph D-12,i.

16. Tests were next made to determine any reduction in the sound pressure output of the sirens as a result of the endurance test.

17. The sirens were then tested to determine their dielectric strength and insulation resistance by subjecting them to twice their rated voltage plus 1250 volts for 1 minute between current carrying parts and ground after which the insulation resistance was measured with a 1000 volt megger.

18. They were next subjected to a 1 inch stream of water, under a pressure head of 35 feet, played from a hose at a distance of 5 feet for 5 minutes, to determine their splashproof integrity.

19. The regular tests were then concluded with a careful examination to determine the effect of the tests on the sirens and their conformance with the specifications relative to design and quality of workmanship and materials.

20. Comparative tests were then made, using the standard and experimental rotors, in order to determine whether the use of the experimental rotors would improve the operation of the sirens.



## RESULTS OF TESTS

21. The test results obtained were as follows:

<u>Requirements</u>	<u>Test Values</u>			
	<u>Type S1</u>	<u>Type S2</u>	<u>Type S3</u>	<u>Type S4</u>
Voltage: 115 volts.	115 volts	115 volts	115 volts	115 volts
Current:	Direct	Alternating	Direct	Alternating
Ampere: Not specified.	1.69 amps.	1.83 amps.	1.86 amps.	1.98 amps.
Watts: Not over 200.	195 watts	184 watts	*214 watts	197 watts
Power factor: Not less than 60 per cent.	--	87.0%	--	87.0%
Weight: Not over 9 lb.	7 lb. 2 oz.	7 lb. 2 oz.	7 lb. 4 oz.	7 lb. 4 oz.
Pitch of note: Type S1 & S2 - 600-1200 C.P.S. Type S3 & S4 - 1750-2500 C.P.S.	990 C.P.S.	920 C.P.S.	1880 C.P.S.	1750 C.P.S.
Sound pressure output: Shall be not less than 95 decibels at 10 feet in a sound-proof room.	100 db	98 db	99 db	99 db
Shock integrity: Shall withstand 20 blows of 20 foot pounds each, under conditions specified under paragraph F-2g.	Complied		Complied	
Vibration tests: Shall be mounted on a standard heavy 3 foot pound vibration machine and subjected to six tests of 30 minutes each at 100, 150, 200, 250, 300 and 350 blows per minute.	Complied		Complied	
Endurance: Shall be operated "one minute on" and "one minute off" for a period of 1500 cycles, the first half at an ambient temperature of 60°C and the second half at 0°C.	Complied		Complied	



Requirements

	<u>Test Value</u>			
	<u>Type S1</u>	<u>Type S2</u>	<u>Type S3</u>	<u>Type S4</u>
Temperature rise: Shall not exceed 45°C at any time during the endurance test.		35.3°C		31.2°C
	<u>Note:</u> Not tested on d.c.			
Dielectric test: Shall withstand a dielectric test of twice the rated voltage plus 1250 volts, at 60 cycles, for a period of one minute.	Complied.		* The brush holder broke down following the endurance test.	
Insulation resistance: Shall be not less than 5 megohms, with a 500 volt megger, after the dielectric test.	200+ megohms.		* Low resistance following the dielectric test.	
Dissimilar materials: Brass shall not be in contact with aluminum.	Complied		Complied	
Wire: Type SICP shall be used.	Complied		Complied	
Inclination: Shall operate in any position when supplied with $\pm 10$ per cent rated voltage and frequency.	Complied		Complied	
Splashproof integrity: Shall be splashed with a 1-inch stream of water, under a pressure head of 35 feet, played from a hose from a distance of 5 feet for 5 minutes without any water entering the case.	Complied		Complied	
Salt spray test: Shall be subjected under ultra-violet light, to a 20 per cent salt spray at 55°C for a period of 3 minutes, followed by an air blast at 55°C for 3 minutes, the cycle being repeated for a period of 100 hours. Shall show no serious corrosion and shall operate satisfactorily at the end of the test.	Not conducted due to satisfactory test reported under reference (c).			

RequirementsTest Values

	<u>Type S-1</u>	<u>Type S-2</u>	<u>Type S-3</u>	<u>Type S-4</u>
Nameplates: Shall be of corrosion resisting material as defined by the specifications.	*Stainless steel used.		*Stainless steel used.	
Case material: Shall be of bronze or aluminum alloy as specified in paragraph D-3.	Complied. Cast aluminum alloy.		Complied. Cast aluminum alloy.	
Terminal block: Shall be of approved material, equipped with terminal lugs in accordance with Eng. Drwg. 9-S-1841-L.	Complied.		Complied.	
Painting: Shall be finished with one coat of zinc chromate paint followed by two coats of aluminum paint and final coat of grey paint.	*Grey paint omitted.		*Grey paint omitted.	

\*Denotes failure to comply with the specifications.

## CONCLUSIONS

22. The sample sirens failed to meet the following requirements of the specifications:

### Type S1-S2

Nameplate (stainless steel).

Finish coat of grey paint.

### Type S3-S4

Nameplate (stainless steel).

Finish coat of grey paint.

Dielectric.

Insulation resistance.

The power consumption was too high at the start of test, but reached a satisfactory value during the endurance tests.

23. The nameplate material should have been of copper-nickel alloy as required by reference (e).

24. The breakdown, under the dielectric test, occurred on one of the brush holders of the S3-S4 siren, piece 5, after the endurance test.

25. The use of the experimental rotors, suggested under manufacturer's letter (enclosure (A) of reference (a)) does not appear to be justified. As is shown by the data of Table 1, their use increases the power consumption without improvement in the characteristics tabulated. No tests were made to verify the manufacturer's claim that their use reduces the temperature rise of the motors through more efficient cooling as the temperature rise of the motors using the standard rotor was satisfactory.

26. As a result of Laboratory experience in changing the rotors several times, it is believed that some simple modification should be made to definitely locate the rotor and establish its clearance in relation to the stator and motor plate. This could be accomplished by the use of a "step" in the motor shaft or rotor bushing, or both.

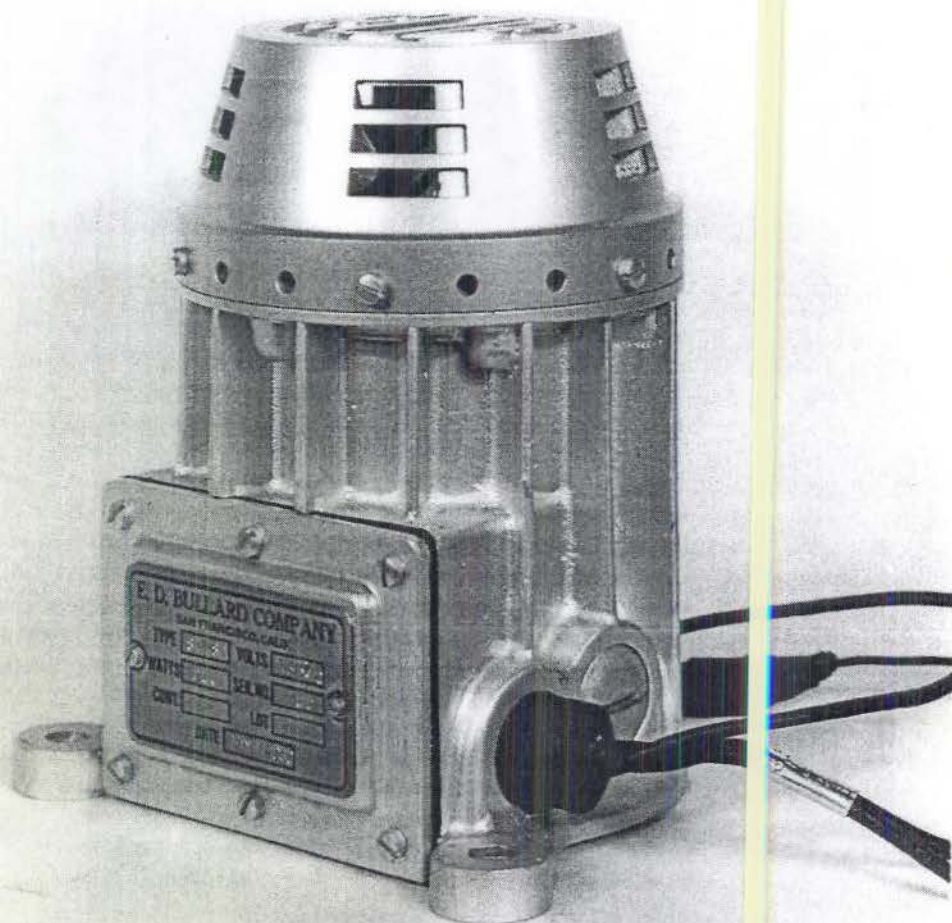


TABLE I

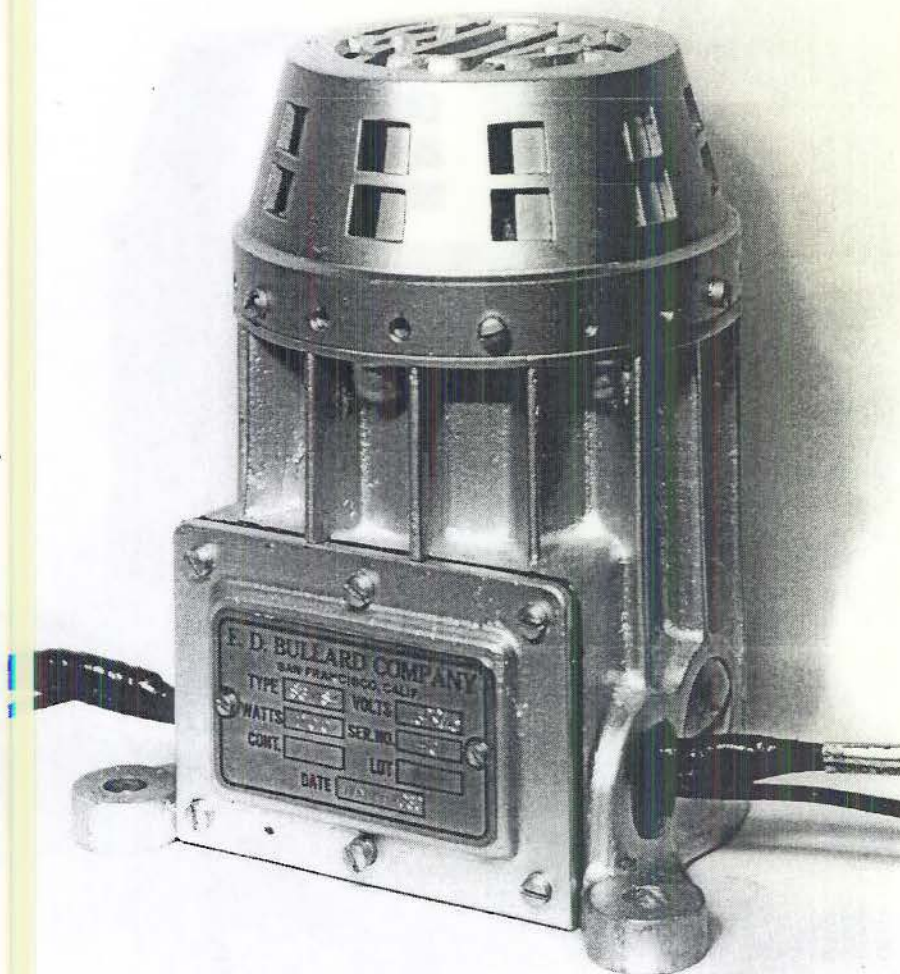
Comparative Results with Normal and Experimental Rotors before and

after endurance tests

	<u>5 Port Sample Tested as S-1 (D.C.)</u>			<u>5 Port Sample Tested as S-2 (A.C.)</u>		
	<u>Normal Rotor</u>		<u>Experimental Rotor - After Endurance Test</u>	<u>Normal Rotor</u>		<u>Experimental Rotor - After Endurance Test</u>
	<u>Before</u>	<u>After</u>		<u>Before</u>	<u>After</u>	
	<u>Endurance</u>	<u>Endurance</u>		<u>Endurance</u>	<u>Endurance</u>	
Volts	115	115	115	115	115	115
Amps.	1.69	1.63	1.98	1.83	1.73	1.83
Watts	195	188	228	184	174	183
Decibels	100	101	103	98	102	102
C.P.S.	990	1000	940	920	970	920
P.F.	---	---	---	0.87	0.87	0.87
	<u>10 Port Sample Tested as S-3 (D.C.)</u>			<u>10 Port Sample Tested as S-4 (A.C.)</u>		
	<u>Normal Rotor</u>		<u>Experimental Rotor - After Endurance Test</u>	<u>Normal Rotor</u>		<u>Experimental Rotor - After Endurance Test</u>
	<u>Before</u>	<u>After</u>		<u>Before</u>	<u>After</u>	
	<u>Endurance</u>	<u>Endurance</u>		<u>Endurance</u>	<u>Endurance</u>	
Volts	115	115	115	115	115	115
Amps.	1.86	1.72	1.79	1.98	1.82	1.86
Watts	214	198	206	197	178	182
Decibels	99	103	99	99	100	98
C.P.S.	1880	1980	1950	1750	1820	1800
P.F.	---	---	---	0.87	0.85	0.85



Type S-1 - S-E Siren



Type S-3 - S-4 Siren